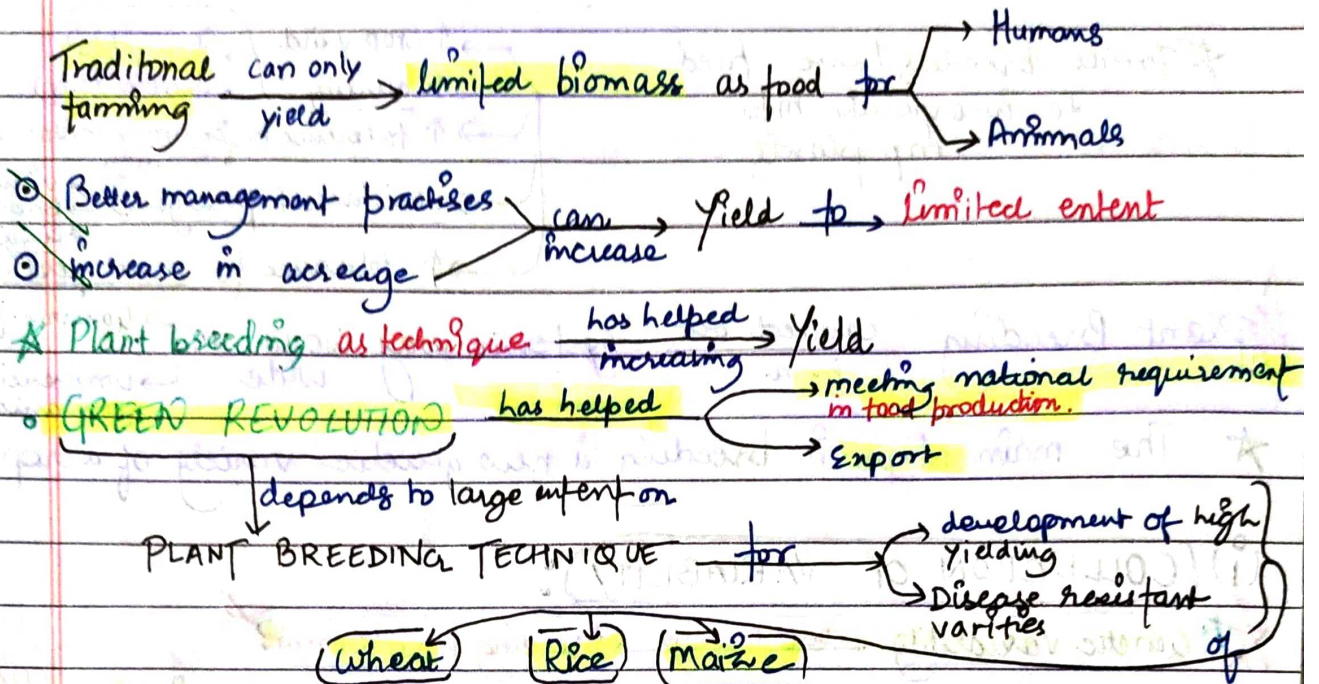
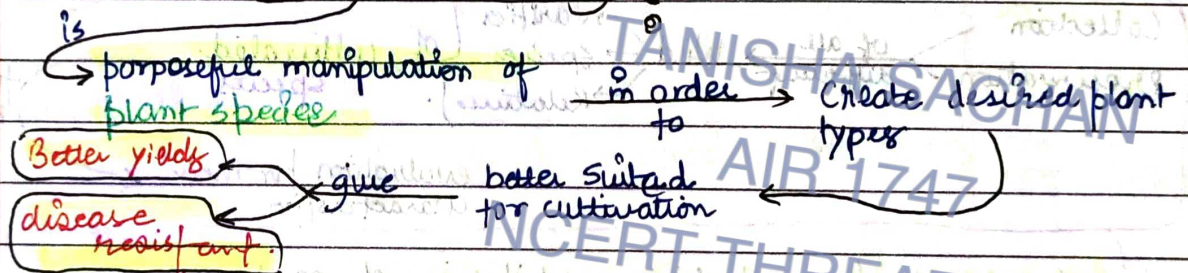


PLANT BREEDING



What is Plant Breeding?



CONVENTIONAL PLANT BREEDING

has been practised for thousands of years

9000 - 11,000 years ago

dates back to Recorded evidence of plant breeding

since the beginning of human civilisation

★ Many present day crops are the result of domestication in ancient times

★ Today all major food crops are derived from domesticated varieties

CLASSICAL PLANT BREEDING

Involves crossing or hybridisation of pure lines

to produce plants with desirable traits of artificial selection pursued by

higher yield nutrition Resistance to disease

With advancement in → genetics
→ molecular biology
→ Tissue culture } Plant breeding is now increasingly being carried out by using molecular genetic tools

★ Traits breeders have tried to incorporate into crop plants

- ↑ crop yield
- ↑ quality
- ↑ tolerance to environmental stress
 - droughts
 - extreme temp
 - salinity
- resistance to pathogens
 - virus
 - Bacteria
 - fungi
- ↑ tolerance to insect pesticide

★ Plant Breeding carried out in a systematic way would be in
 → Government institution
 → commercial companies

★ The main steps in breeding a new genetic variety of a crop —

(i) (COLLECTION OF VARIABILITY):

★ Genetic variability — root of any → breeding programme

In many crops → pre-existing genetic variability is available from Wild relative of the crop

Collection of all different Wild varieties, species, relatives of cultivated species followed by evaluation for their characteristics

pre-requisite for → effective exploitation of natural genes

Gerplasm Collection → Entire collection of populations of plants & seeds having all alleles for all diverse genes in a given crop

(ii) (EVALUATION & SELECTION OF PARENTS):

Geroplasm → evaluated → so as to identify plants with desirable combination of characters.

Used in process of hybridisation selected plants are multiplied

★ Purelines are created whenever desirable possible

(ii) CROSS HYBRIDISATION AMONG THE SELECTED PARENTS :

Desired characters have very often to be combined from 2 different plants. (parents)

Eg → High protein quality of one parent (crossed) Disease resistant from another plant

possible by
Cross hybridising 2 parents to produce hybrid

Genetically combined the desirable characters in one plant

This part very time consuming tedious process } since → pollen grains (from ♂) have to be collected

It's not necessary that hybrids do combine the desirable characters

also stigma of selected ♀ plants. plotted on

Usually 1/100 or 1000 crosses give desirable combination

(iv) SELECTION & TESTING OF SUPERIOR RECOMBINANTS:

This step consists → selecting among progeny of hybrids

Selection process crucial to the success of breeding objective

those plants have desired character combinations

and required careful scientific evaluation of progeny.

- This step yields plants that are superior to both of parents (plants).
very often → more than one superior progeny plant may become available.

These are self pollinated → for several generation till they reach

The characters will not segregate in the progeny.

so that a state of uniformity (HOMOZYGOSITY)

(V) TESTING, RELEASE AND COMMERCIALISATION OF NEW CULTIVARS:

① Newly selected lines

are evaluated for their

Yield

& other agronomic traits of quality & disease resistance

Evaluation is done by

Growing these in the research fields

& recording their performance

under

ideal fertilizer application

irrigation

crop management practices.

Evaluation in research fields is followed by testing the material

all the agro-climatic zones

representing

several locations in country

at

farmer's field

3 growing seasons

for atleast

Where Crops are usually grown

★ Material is evaluated → in comparison to → best available local crop cultivar

Check / Reference cultivar

Known as

INDIA is Agricultural country

Agriculture

accounts for

33% of India's GDP

After India's Independence

one of main challenges

prod. enough food for ↑ population

As only limited land

fit for cultivation

↑ yields/area (from existing farm land)

INDIA has to strive

GREEN REVOLUTION → Development of several high yielding varieties of

Various plant breeding technique

as a result of

mid 1960s

in

wheat

rice

led to → Dramatic ↑ in food production in country.

Wheat

During 1960-2000 → Wheat production increases
11 - 35 million tonnes

↓ due to development of dwarf varieties
★ In 1963 → Sonalika + Kalyansona

high yielding + disease resistant
introduced all over the wheat growing belt of India

Rice

During 1960-2000 → Rice production increases
35 - 89.5 million tonnes

↓ due to development of dwarf varieties
★ Semi dwarf Rice varieties derived from

IR-8 developed at IRRI Philippines
Taichung Native 1 from Taiwan

International Rice Research Institute
introduced in 1966
Later introduced → Jaya, Ratna developed in India

Nobel Laureate → Norman E. Borlaug at International Centre for Wheat Maize Improvement
developed semi dwarf wheat in Mexico

Sugar Cane

→ Saccharum Barberi

was originally grown in North India
but had poor yield, poor sugar content

Tropical canes grown in South India (Saccharum Officinarium)
did not grow well in North India
thick stems, higher sugar content

★ These 2 species → crossed successfully to get Sugar Cane varieties

combining desirable quality of
• High yield
• High sugar
• Ability to grow in North India
• Thick stems

MILLETS

→ Hybrid maize, Jowar, Bajra } have been successfully developed in India

Hybrid Breeding have led to development of several high yielding varieties resistant to water stress

Plant Breeding For Disease Resistance

• Wide range of $\left\{ \begin{array}{l} \text{fungal pathogen} \\ \text{viral} \\ \text{bacterial} \end{array} \right\}$ affect the yield of crop/cultivated crop species especially in **Tropical climates**

• Crop losses can be significant up to **20-30%** / sometimes total
 resistant to disease ← Cultivars ← breeding & development - ent in this situation
 → enhances food production

this also helps → Reduce the dependence on use of fungicides Bactericides

Resistance of host plant is the ability to prevent the pathogen from causing disease

determined by **Genetic constitution of host plant**

Before breeding is undertaken we should know $\left\{ \begin{array}{l} \text{Causative organism} \\ \text{Mode of transmission} \end{array} \right\}$

Disease
 caused by

Fungus

- Brown rust of wheat
- Red rot of sugarcane
- Late blight of potato

Bacteria

- Black Rot of Crucifers

Virus

- Tobacco mosaic
- Turnip mosaic

Methods of (Breeding) for Disease Resistance:

is carried by either for

Conventional Breeding Technique

This method is of

Hybridisation

Selection

Its steps are essentially identical to those for

Breeding for any other agronomic characters

such as High yield.

Mutation Breeding

Mutation a process by which Genetic variations are created

through changes in Base sequence within genes

resulting in

Creation of a new character

Trait not found in the parental type.

Various Sequential steps

1) screening germplasm \rightarrow for **Resistance sources**

2) Hybridisation of selected parents

3) Selection Evaluation \rightarrow of hybrids

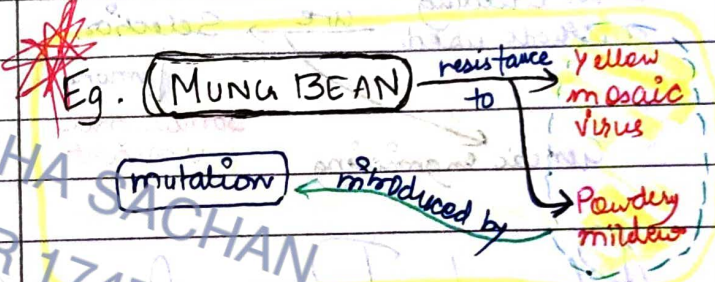
4) Testing Release \rightarrow of new varieties

★ By this method, resistances developed

It's possible \rightarrow to induce mutations artificially
 through use of chemicals or Radiations like γ -radiations

○ By selecting & using the plants

at a source in having desirable char. acerb.
 breeding \rightarrow this process is **MUTATION BREEDING**



○ Several wild relatives of different cultivated species of plants

Certain resistance characters but have \downarrow yield.

have been shown to have

Hence \rightarrow there is need to introduce resistant genes

High yielding cultivated varieties \leftarrow intro

Eg \rightarrow **ABEL MOSCHUS ESCULENTUS** (bhindi)

resistance to **Yellow mosaic virus**

PARBHANI KRANTI

resulted in new variety

space for table

Conventional Breeding is often

constrained by

"availability of limited no. of disease resistance genes"

that are present & identified in

Various crop varieties

Wild relatives

All above examples involve

Source of Resistance genes

that are in

Same crop species

\downarrow which has to be bred

Related wild species

Inducing mutations in plants
screening the plant material then diverse means through
for Resistance

desirable gene being identified sometimes lead to

Plants having desirable characters

can be either for
multiploid directly

used in breeding

Other breeding methods used

are

Selection

among

Somacultural variants

Genetic engineering

for disease resistance

★ Transfer of genes is achieved by

Sexual hybridisation

target

source plant

followed by Selection

TANISHA SACHAN

AIR 1747

NCERT THREAD NOTES

Plant Breeding For Developing Resistance to Insect Pests

due to insect & pest infestation major cause for large scale destruction of

Crop plant

Crop produce

① Insect Resistance in

Host crop plants

maybe due to

Morphological charact.
biochemical charact.
physiological charact.

② Hairy leaves in several plants

associated with

Resistance to insect pests.

eg.

Cotton = Resistance to Jassids

Wheat = Resistance to Cereal leaf beetle

• In wheat → Solid stems lead to non-preference by the stem sawfly

• In cotton → smooth leaved nectarless cotton } do not attract Bollworms

maize → High aspartic acid
Low nitrogen
Sugar content } leads to resistance to Stem borer.

★ Breeding methods for insect pest resistance involves same steps as those of any other agronomic trait.

Such as
Yield
Quality

★ Source of Resistance genes
→ cultivated varieties
→ germplasm collections
→ Wild relatives

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NCERT THREAD NOTES

Plant Breeding for Improved Food Quality

★ More than 840 million people in world do not have adequate food to meet daily food Nutritional requirements.

★ > 3 billion suffer from micronutrient Protein Vitamin deficiencies OR Hidden hunger } because they cannot afford to buy.

① Diets lacking → Essential micronutrients Fruits Vegetable legumes fish meat

particularly
Fe Vit-A Iodine Zn

Risk for disease

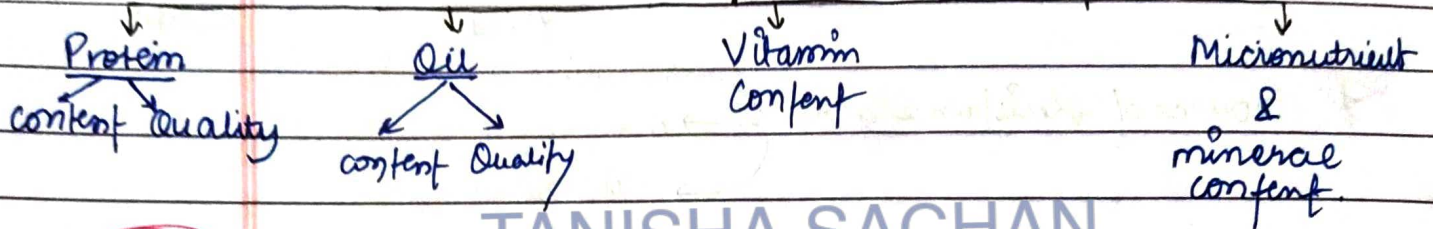
Reduce lifespan

Reduce mental abilities

Biofortification → Breeding crops with vitamins minerals protein healthier fats
 most practical way to improve public health

Breeding for Improved nutritional Quality is undertaken

with objective of



In 2000, Maize hybrids had 2X amt of amino acids
 existing maize hybrids as compared to lysine Tryptophan

Wheat variety → Atlas 66 have ↑ protein content
 been used as a donor for improving wheat.

It is possible to develop Rice Variety iron fortified having 5X amt of Fe

IARI, New Delhi has released Several vegetable crops that are rich in vitamins minerals

Vitamin A enriched	Vitamin C enriched	Fe & Calcium Enriched	Protein enriched
<ul style="list-style-type: none"> Carrots spinach Pumpkin 	<ul style="list-style-type: none"> bitter gourd batthua mustard Tomato 	<ul style="list-style-type: none"> spinach batthua 	<ul style="list-style-type: none"> beans <ul style="list-style-type: none"> Broad lablab French beans Hard-en beans

SINGLE CELL PROTEIN

Conventional Agricultural Production of cereals pulses vegetables fruits

• may not be able to meet demand of food at the rate at which is increasing

Human population → Animal population

* The shift from grain to meat diets } also creates more demand for cereals

animal farming ← by { 1 kg of meat ← to produce 3-10 kg of grain ← as it takes

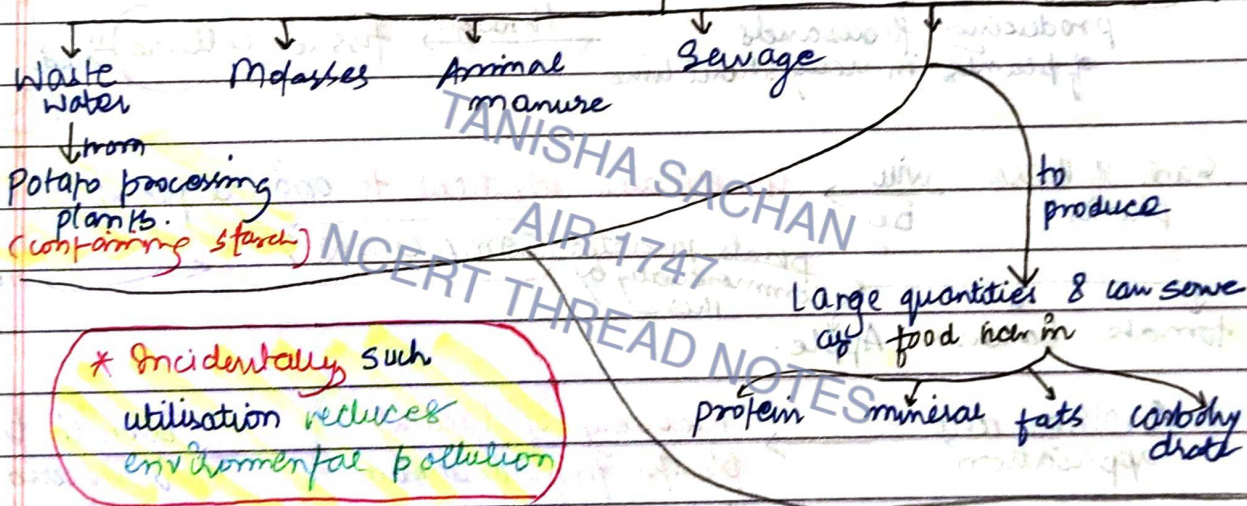
> 25% of human population is suffering from hunger & malnutrition

* One of alternate sources of proteins for animal & human nutrition

(SCP) Single Cell proteins

* Microbes are being grown on an industrial scale as a source of Good proteins

BGA like → Spirulina → can be grown easily on materials like



* Certain bacterial species like Methylobacillus & Methylococcus produce biomass prod. & Growth. bcz of its high rate of 25 times of protein

* The fact that Edible mushrooms are eaten by many people

Large scale mushroom culture is a growing industry
↓ makes us believe
microscopic fungi too would become acceptable as food.

TISSUE CULTURE

As traditional breeding technique failed to meet demand & provide sufficiently fast & efficient system for crop movement.

It was by scientists during 1950's → whole plant from any → **EXPLANATION**

any part of plant taken out & grown in test tube ← definition

sterile conditions

under

Special nutrient medium

TOTIPOTENCY → Capacity to generate a whole plant from any → cell/enplant

* Nutrient Media must provide

- Carbon source → **Sucrose**
- Inorganic salts
- Vitamins
- AA
- like Growth regulators
- Cytokinin
- Auxins

By application of → these methods → it's possible to achieve propagation

Very short duration → large no. of plants

This method producing thousands of plants in very short time through tissue culture → **MICRO PROPAGATION**

Each of these plants will be **Genetically identical to original plant** → **SOMACLONES** → i.e. they are

plants generated commercially by this

tomato banana Apple.

* Another app. → Recovery of healthy plants from diseased one. → Even if plant is infected with a virus

One can remove meristem hence → and grow them in vitro to obtain virus free plants

Meristem → apical → axillary

is free of virus

Scientists have succeeded in culturing meristems of

banana
Sugarcane
Potato

Scientists have isolated → single cells
born 2 inspire

Date ____ / ____ / ____ from

digesting their cell walls ← after plants

have been able to isolate

naked protoplasts

from 2 different varieties

of plants

a desirable character

each having

used to get

Hybrid protoplasts

new plant

can be further grown into

These hybrids

are called

Somatic hybrids

Somatic hybridisation

Process is called

Protoplast of Tomato

+
protoplast of Potato

grown to form

New plants (hybrids)

combining

Tomato & Potato characteristics

NCERT THREAD NOTES

This has been achieved

resulting in form of

POMATO

unfortunately

Plant didn't have all desirable combination for commercial utilisation

Q. Various components of medium used for propagation of an explant in vitro?

- Carbon source - sucrose
- Vitamins
- Minerals
- Water
- Agar Agar
- Auxin
- Gibberellin
- AA.

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NCERT THREAD NOTES

① Tissue culture

② Somatic hybridisation

offers vast potential
for manipulation of
plants IN VITRO
to prod. new varieties